DOCUMENT RESUME

ED 381 993 EC 303 949

AUTHOR Rosman, Nancy J. Spiegel
TITLE Effects of Varying the Special Educator's Role within an Algebra Class on Math Attitude and Achievement.
PUB DATE May 94
NOTE 88p.; Master of Arts Thesis, University of South Dakota.
PUB TYPE Dissertations/Theses - Masters Theses (042) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Algebra; High Schools; Inclusive Schools; Intervention; *Mainstreaming; *Mathematics Instruction; Sex Differences; *Special Education Teachers; *Special Needs Students; *Teacher Role; Teaching Methods
IDENTIFIERS *Teacher Collaboration

ABSTRACT

This study compared the effects of two different special educator roles within high school algebra classes containing special needs students. The special educator served as either in-room assistant or as co-teacher. The study was conducted for one chapter of algebra study over a 3-week period. No significant differences between groups were found prior to the treatment. Following the two treatments, students in the co-teaching condition scored significantly higher in achievement than did students in the in-room assistance group or the control group. Females in the co-teaching condition achieved significantly higher scores than did females in the control group. Females receiving in-room assistance also scored significantly higher than control group females. No significant findings in achievement were found for males or for students receiving special education services. Appended are forms used in the program and a brief description of the collaboration model. (Contains 61 references and 15 tables.) (DB)

EFFECTS OF VARYING THE SPECIAL EDUCATOR'S ROLE WITHIN AN ALGEBRA CLASS ON MATH ATTITUDE AND ACHIEVEMENT

by

Nancy J. Spiegel Rosman

B.S., University of Wisconsin-Eau Claire, 1981

A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
Master of Arts

Department of Special Education
in the Graduate School

The University of South Dakota
May, 1994

THESIS COMMITTEE

The members of the committee appointed to examine the thesis of Nancy J. Spiegel Rosman find it satisfactory and recommend that it be accepted.

Linda Reetz
Dr. Linda Reetz, Chairperson

Dr. Pat Vitale

Dr. Roger Parsons

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to Dr. Linda Reetz for her time and support throughout my master's program. Her belief in my capabilities and her professional leadership will not be forgotten. I thank Dr. Parsons for his constructive guidance in clarifying my complex thoughts. His commitment to improving mathematics education for all students is inspiring. I appreciate Dr. Vitale's expertise in statistics which has added another dimension to my research findings. As my committee members, they have guided me through a complex process with kindness and caring.

I wish to recognize and thank my husband, Michael, for his patience and understanding throughout my program. His support of my professional dreams has been instrumental in making this step a reality. To my sons, Adam and Paul, for being all-around great kids and understanding why I needed to be a teacher and a mom. To my parents and siblings, sincere gratitude for their loving support.

To Carol Petit, thanks for the thousands of miles of conversation and encouragement. To my colleagues who enjoyed my role as an intern and a researcher, thank you for reminding me to laugh. A special thanks

to the algebra teachers who welcomed me into their classrooms. I express sincere appreciation to my school district for providing sabbatical leave to veteran teachers.

Finally, I wish to thank the American Association of University Women Educational Foundation for the Eleanor Roosevelt Teacher Fellowship which made this project possible.

ABSTRACT

Nancy J. Spiegel Rosman, Curriculum and Instruction, Department of Special Education, The University of South Dakota, 1994

Effects of Varying the Special Educator's Role Within an Algebra Class on Math Attitude and Achievement

The purpose of this study was to identify if varying the role of the special educator within an algebra class would affect student math attitude and achievement. The population involved were students enrolled in a midwestern high school's adjusted algebra class. The special educator assumed the role of in-room assistant in one group and the co-teacher role in the second treatment group. A control group continued with traditional instruction by the algebra teacher without the aid of the special educator. The study was conducted for one chapter of study over a three week period. Post-treatment data was analyzed using analysis of variance with covariate. Pre-treatment data was utilized as a covariate to allow for initial differences in groups. There appeared to be no significant differences in attitude between groups or subpopulations. Students in the coteach-1 group scored significant higher in achievement than the students in the control group as well as higher than students in the in-room assistance group. Also females in the both

co-teaching groups achieved significantly higher than females in the control group. Females receiving in-room assistance also scored significantly higher than the control group females. No significant findings in achievement were found for males or students receiving special education services.

CHAPTER 1

Introduction

As the platitudes for restructuring echo through school hallways and legislative sessions, educators explore the possibilities for changes in service delivery and curriculum. The identification of national standards in math and science is an indicator that the public is seeking a means for identifying quality education. The Regular Education Initiative (REI) is also impacting the push for higher standards in public education (Will,1986). As public policy, REI sets forth the philosophy of one educational system that meets the needs for all children. Under these conditions, educators need to assess the effectiveness of alternative delivery services when working with students who are having difficulty meeting the higher standards set forth for "all" students.

Background

As the twentieth anniversary of the passage of Public Law 94-142 approaches, special education professionals reflect back on their accomplishments. Public Law 94-142, the Education for All Handicapped Children Act in 1975, mandated that no child could be denied an appropriate public education in the least restrictive environment. All children had a right to

be educated with their peers in the least segregated arrangement possible (Stainback, Stainback, & Forest, 1989).

Concerns continue to surface regarding the effectiveness of secondary special education programs. Studies of high school graduates with disabilities have documented the lack of successful transition into adult life (deBettencourt, Zigmond, & Thornton, 1989; Haring, Lovett, & Smith, 1990; Hartzell & Compton, 1984; Hasazi, Gordon, & Roe, 1985; Humes & Brammer, 1985; National Longitudinal Transition Study, 1989; Schalock, Wolzen, Ross, Elliot, Werbel, & Peterson, 1986; Scuccimarra & Speece, 1990). In the Twelfth Annual Report to Congress on the Implementation of The Education of the Handicapped Act (United States Department of Education, 1990), only 18% of students with disabilities were served in the regular classroom during the 1987-88 school year. The majority of high school special education programs continue to be a pullout adaptation of the elementary resource model (Adelman, 1972; Deshler, Lowrey, & Alley, 1979; Friend, 1988; Jenkins & Heinen, 1989; Lewis, 1974; Sabatino, 1972). In light of the above reports, the Regular Education Initiative appears to set forth

strong argument for educating more students with disabilities in the regular classroom.

Simultaneously, schools appear to filter out mass numbers of students from the mathematics curriculum. From high school through graduate school, half of the students in mathematics leave each year (National Research Council, 1989). This reduction creates grave concern when over 75% of all jobs require for training programs or licensure basic algebra and geometry skills (National Research Council, 1989). When determining the national mathematics standards, the National Council of Teachers of Mathematics Board of Directors endorsed the goal that every child receive a comprehensive mathematics education (National Council of Teachers of Mathematics, 1991). NCTM recognizes that "every" is not inclusive, yet NCTM's intent is to push educators beyond their current perceptions of who can and cannot gain something from higher mathematics coursework. The NCTM Standards (1989) seek shifts in the environment of the mathematics classroom, including moving from memorization to reasoning, toward logic as verification instead of the teacher, and toward application and problem-solving (NCTM, 1991).

When educators contemplate unifying REI and the NCTM Standards in the restructuring efforts, many

teachers acknowledge the need to modify traditional curricula to meet the needs of an increasingly diverse student population. Teachers lack the training and the time to develop effective programs and curricular materials (Baker & Zigmond, 1990; Deshler, Lowrey, & Alley, 1979; Myles & Simpson, 1989). They feel ill-prepared for the most challenging sector of students--the one-third of the student body who are having difficulty in school (Idol, West, & Lloyd, 1988; Simpson & Myles, 1990; Vatter, 1992; Will, 1986).

By altering the role of the special educator from direct service provider to team or co-teacher, curricular and instructional modification problems can be dealt with directly in the regular classroom (Reynolds & Volkmar, 1984). Direct interaction and equal responsibility for all students by a special educator and a regular educator facilitate the acceptance of the REI principles of partnership.

Statement of the Problem

Currently, new methods for the delivery of mathematics instruction in regular education settings are being attempted. In addition, more students with math deficits are being required to achieve higher mathematical competency. This study placed a special educator within the regular education secondary classroom. By varying the level of direct instructional responsibilities of the special educator within the adjusted algebra class, this study sought to identify the most effective role of the special educator when paired with a regular educator.

Research Hypotheses

The following research hypotheses were identified:

1. There will be a significant difference in math attitude scores for students receiving traditional algebra instruction compared to co-teaching instruction.
2. There will be a significant difference in math attitude scores for students receiving co-teaching instruction compared to traditional instruction with in-room assistance.
3. There will be a significant difference in math attitude scores for students receiving traditional algebra instruction compared to students receiving tradition instruction with in-room assistance.
4. There will be a significant difference in math achievement scores for students receiving traditional algebra instruction compared to students receiving co-teaching instruction.
5. There will be a significant difference in math achievement scores for students receiving co-teaching instruction compared to students receiving traditional instruction with in-room assistance.
6. There will be a significant difference in math achievement scores for students receiving traditional algebra instruction compared to students receiving tradition instruction with in-room assistance.

Definitions

The following words are defined as they specifically apply to this study:

ACHIEVEMENT SCORES: Percentages from the total points possible on chapter assignments and quizzes will be utilized.

ADJUSTED ALGEBRA: Traditional one-year algebra course taught at a slower rate of instruction to allow students additional practice to achieve mastery of concepts. Basics of Algebra was the title used for this course at this particular school.

ATTITUDE SCORES: Scaled scores from the Test of Mathematical Ability (TOMA) subtest one: Attitude Towards Math will be utilized.

CO-TEACHING: A team of an algebra teacher and a special educator who assume equal responsibility for instruction and classroom management of all students within that one classroom.

IN-ROOM ASSISTANCE: A special educator within the classroom who helps any student only when requested and on a one-to-one basis. The special educator does not do any large group instruction nor classroom management.

STUDENTS WITH MATH DEFICITS: Students who received a C or lower in eighth grade pre-algebra. In the past, these students would have been enrolled in general or consumer math in high school.

Limitations

The limitations of this study were as follows:

1. Although students were assigned by a computer, the randomness of assignment could not be verified.
2. The researcher participated in the instructional process of the study.
3. The impact of being a female within a male teacher's classroom was not controlled for within the study.
4. The study was conducted in the largest school district in a rural state and may not be representative of the typical instructional settings in this rural state.
5. The sampling subpopulations were small.

Significance of the Study

Although team teaching has been implemented in a variety of ways over the last forty years, there is little empirical research to document its effectiveness. The practice has appeared to gain support through affirmation rather than validation-through-empirical evidence (Armstrong, 1977). Friend, Reising, and Cook (1993) agreed that teachers seem to be rewarded and challenged in co-teaching situations, allowing them to individualize and diversify learning activities. Friend et al. (1993) stated that minimal research exists that confirms co-teaching is more effective than other delivery methods.

The Ford Foundation (1972) conducted a comprehensive school improvement program from 1960 through 1970. Twelve encouraging practices were identified with team teaching being the most frequently observed. However, the phrase "team teaching" was noted as ranging from coffee chats to a group with a leader doing joint planning. Rarely did the Ford Foundation find practices of team teaching that created a situation where two or more teachers were all equally responsible for one group of children.

Studies have been conducted at the elementary and middle level regarding team teaching. For example,

Burningham in 1968 (cited in Armstrong, 1977) conducted a study of fourth graders receiving instruction from traditional and team teachers. Scores were significantly better in mathematics and science for the students in the team-taught classes.

Many short-term studies have not identified significant differences between team and traditional instruction. Lambert, Goodwin, and Wiersma (1965) found that students who received solitary teacher instruction scored higher during the first year of the study than those students who had received team-taught instruction. In the following year, both the second and the first year team-taught samples scored higher in reading, language, and total achievement. Lambert et al. (1965) concluded that the team teachers' relationship needed to develop before the full impact of team teaching would become measurable.

At the middle school level, Klausmeier and Wiersma (1965) conducted a study of seventh graders in English and social studies. Low ability homogeneously grouped students who received team-taught instruction scored significantly higher than any group receiving traditional solitary-teacher instruction. Further research was recommended to investigate the impact of team teaching on students with lower ability.

Armstrong (1977) draws two possible rationales for many studies finding "no differences" in scores. First, many studies are short-term and in view of the Lambert et al. (1965) finding the impact of team-taught instruction may not be identifiable initially. Second, studies identify the two delivery methods of instruction, but do not delineate whether instruction itself substantially changed.

In addition, few studies infused the strategy expertise of a special educator with the content expertise of the regular education teacher. Team teaching frequently referred to two or more regular education teachers sharing the responsibility of instructing a group of students, not necessarily cooperatively in one classroom as co-teaching does (Armstrong, 1977; Ford Foundation, 1972). Friend et al. (1993) indicated the need for empirical studies that evaluate the impact of co-teaching, and not team teaching, on students. This study provides a beginning piece of empirical data in support of co-teaching practices.

CHAPTER 2

Review of Related Literature

Introduction

With the passage of Public Law 94-142, the Education for All Handicapped Children Act of 1975, school districts rapidly developed secondary special education programs to comply with the regulations for providing all children ages three to twenty-one with a free and appropriate education in the least restrictive environment. These programs were not necessarily effective quality programs. Touzel (1978) described the state of secondary special education programs by writing:

> "...existing secondary programs are often characterized by unverifiable results, inappropriate instructional and management procedures, and widely differing focuses." (p. 53)

In a review of model programs which had some documentation of being successful, seven common characteristics were identified (Riegel & Mathey, 1980). First, all successful programs began with acknowledging the unique characteristics of secondary students with disabilities. These characteristics include, but are not limited to, a failure in mastering

basic skills and an inability to cope with regular secondary classroom demands.

Second, the programs acknowledged that programming for only individuals identified with disabilities is not enough. It is believed that one-third of all students at the secondary level are experiencing some significant difficulty with academics (Simpson & Myles, 1990). If special education services assist 10-12% of that population, then school officials need to program within the regular curricula for the other 20% of students having difficulty.

Third, the programs acknowledged that the environment within which the student functions while in school and after graduation needs to be considered when developing programming. Transition planning from the school environment to adult independence becomes a major focus at the secondary level.

Fourth, all models explicitly stated their philosophy. Although the models advocated various skills as necessary to succeed and the utilization of varying instructional methodologies, each model focused on support services beyond the special education pullout classroom. This focus emphasized that the education of every youth with disabilities cannot be the full responsibility of special education alone.

Fifth, each model emphasized the need for indirect services necessary to achieve a successful experience in the regular classroom. Cooperative planning time for regular and special education staff required administrative support in terms of time allocations.

Sixth, each model identified the need to modify and expand the instructional materials available to the regular education teachers. Various reading levels of materials, tests, and textbooks, as well as a variety of teaching methods, needed to be readily available if regular education teachers are to utilize them (Ellett, 1993).

Finally, the strongest characteristic of all the models was the clear commitment to generalizations and maintenance of skills and concepts beyond the special education classroom into the regular education classroom and beyond the school itself.

In summary, these seven characteristics indicated that special educators need to be assisting with support services and creating materials for regular education teachers to be comfortable with teaching all students. Public Law 94-142 also mandated the utilization of supplementary aids and services within the regular classroom to assist students with

disabilities to achieve satisfactorily (Federal Register, 1992).

Current program practices did not appear to be effective in successfully educating students with disabilities. Dropout studies with students who have disabilities created a shock wave of concern in the early 1980s. Students with disabilities were dropping out of school at a rate of 30%- 47% (Edgar, 1987; Zigmond, 1990) and, of those who did graduate less than 15% had employment with a salary above minimum wage (Edgar, 1987). In the Tenth Annual Report to Congress on the Implementation of The Education of the Handicapped Act (United States Department of Education, 1988), 26% of students receiving special services dropped out. The number of ninth grade students, whether receiving special services or not, dropped out at the same rate; however, 40% of those students not receiving special services returned to complete the General Education Diploma program or regular high school coursework. This return rate was not true for students who had been in special programs. Students with disabilities were not leaving high school, they were abandoning their educational future.

It is in this setting that the field of special education evolved into its next phase--collaboration

and inclusion. The term "mainstreaming" was replaced by "inclusion" as professed by the Regular Education Initiative (Will, 1986). Until this time, mainstreaming programs involved barely 5% of students with mild or moderate needs (Sansone & Zigmond, 1986). In 1988, the regular classroom was the service location for only 18% of students with disabilities (United States Department of Education, 1990). These same programs need to provide the indirect service supports necessary for successful student experiences (Baker & Zigmond, 1990).

Collaboration

The Regular Education Initiative (Will, 1986) strongly impacted the movement for inclusion. The Regular Education Initiative (REI) was a philosophical viewpoint that neither contained a clear definition of its intention nor did it have solid empirical foundation. It did, however, provide education with a focal point for its thinking regarding reform and restructuring. REI called for a partnership of special and regular education services. Although the term partnership was not well-defined in the document, it was followed by the concepts of "less restrictive", "more mainstreamed", and "education for students who have disabilities or are at-risk". REI recommended a

return of school management back to building staffs and students back to the regular classrooms. The educational restructuring REI recommended was designed to make "general education flexible, supple and responsive--educating the full range of students" (Lipsky & Gartner, 1987, p. 72). The regular education teacher would have the following five responsibilities according to Jenkins, Pious, & Jewell (1990):

1. Educating all students assigned to them.
2. Making and monitoring major instructional decisions for all the students in their class.
3. Providing instruction that follows a normal developmental curriculum.
4. Managing instruction for diverse populations.
5. Seeking, using and coordinating assistance for students who require more intense services than those provided to their peers. (pp. 481-482)

If Public Law 94-142 specified that students with disabilities were to be educated with their peers to the greatest extent possible (i.e., the least restrictive environment), then special educators must have some experience with collaboration as a service delivery model in regular education. Collaboration,

known previously as consultation, has existed in a multitude of forms since the mid-seventies (Bauwens & Hourcade, 1991; Friend, 1988; Johnson & Johnson, 1986; Pugach & Johnson, 1988; West & Idol, 1990).

Initially, consultation sprang from the medical model with the expert giving advice to the less-informed. The consulting teacher model developed on the basis that if the regular education teachers were assisted with the instructional demands of educating all students, then pullout services could be reduced (Huefner, 1988).

The purest form of consultation was strictly an indirect service to students (Huefner, 1988; Idol, 1986; Lilly & Givens-Ogle, 1981). In an indirect service model, the special educator consults with the teacher, but never works directly with the students. The special educator-consultant position would assist with the planning of student instruction, but not to relieve the teacher from teaching all students. The consultant played a significant role in the pre-referral process, documenting modifications that had been initiated and their success rates.

Careful planning prior to the implementation of a consultation model needed to be completed. Seven risks resulting from insufficient planning had been

identified by Huefner (1988). First, in hopes of reducing budgetary costs, a district may add consultation to the duties of a resource teacher. Recommended caseloads for consultants whose duties are exclusively consulting was no more than 35 students (Idol, 1986). If the consultant also had direct service responsibilities, a caseload of no more than fifteen was recommended (Lilly, 1977). Second, the consultant's role within the regular education classroom may evolve into a tutorial or paraprofessional position. Third, the model may be seen as a cure-all for every student in every classroom. Fourth, the staff, both special education and regular education, may not have the training or the time to effectively plan and implement instructional alternatives. In-services and funding may result in staffing cuts as students return to the regular classroom. Or, in reverse, if any student benefiting from consultation is "identified in need of special services", then special education explodes. Sixth, the district may assume that consultation will reduce spending by reducing direct services. Finally, the consulting model has little empirical data to support its effectiveness (Huefner, 1988). Also this expert position was not well-received by regular education

teachers, who had significantly more students, more classes, and more materials to cover than the special educator giving advice (Cuban, 1986).

Although ineffective and poorly implemented, consultation in some form appeared to be a necessary component of a full continuum of special services. Hence, consultation, modified in varying degrees of its true conceptualization by school districts, had broadened and blended into an ambiguous term. Consultation delivery services included collaboration, collaborative problem-solving (Pugach & Johnson, 1988), collaborative teaching (Bauwens, Hourcade, & Friend, 1989), team teaching and co-teaching (Bauwens & Hourcade, 1991), cooperative learning (Johnson & Johnson, 1986) and consultation (Friend, 1988). Each teacher, author, or presenter must carefully define what model was utilized as the terminology does not provide clear delineation of what was implemented.

Indeed, in the 1990s, consultation became collaborative consultation and the role of the special educator changed again. No longer the expert giving advice, the special educator recognized the need for shared responsibility and reciprocity in solving the instructional problems of students who had disabilities within the regular education classroom. Collaborative

consultation provided assistance to the regular educator in three areas: (a) prevention of behavior and learning problems, (b) remediation of behavior and learning problems, and (c) coordination of instructional programs (West & Idol, 1990).

West and Idol (1990) concluded that two shifts were imperative to create positive results with collaborative consultation. First, the focus must shift from specialized programs to a school-wide system of educating all children. Second, there must be a shift from being "experts" to a truly shared decision-making, problem-solving collaborative effort by all educators. Paralleling the Regular Education Initiative, these shifts would enable schools to educate all children successfully.

Branching off from the collaborative consultation model is the concept of co-teaching. The co-teaching model unites a regular educator and a special educator in delivering instruction to students in a single classroom. A qualitative study of practicing co-teachers in Colorado conducted by Adams and Cessna (1993) determined five commonalities of successful co-teaching teams.

First, the special educator on the team did not act as a paraprofessional. The co-teaching

relationship was collaborative. It was based on parity, shared responsibility, and mutual accountability.

Second, the teams in Adams and Cessna's 1993 study felt energized and creative. The co-teachers reported that the experience had provided them with a sense of support. They were willing and able to share their unique teaching skills.

Third, effective co-teaching allowed for the classroom activities to continue, while individual students received needed support. Assisting individual students was not the sole responsibility of the special educator. Rather both teachers were recognized by the students as equally responsible for instruction and for assistance.

Fourth, the co-teaching relationship was based on trust. Careful planning took place before the co-teachers actually began teaching together in a classroom.

Finally, successful co-teachers reported they did not "want to do it any other way!" (Adams & Cessna, 1993, p. 31). They felt that they and their students had learned and experienced more by co-teaching than by traditional instruction.

Co-teaching models have developed into a variety of structures (as cited by Friend, Reising, & Cook,

1993). Station teaching involves the teachers dividing the content and each is responsible for only the assigned portion. Parallel teaching requires joint planning of instruction, but the class is divided into halves. Each teacher is responsible for instructing his/her respective half of the students. The One teach, One assist structure allows for one teacher to lead instruction, while the other assists students. Team teaching is characterized by both teachers sharing instruction for all students.

Although the structure of co-teaching may vary, certain issues must be addressed prior to the implementation of a co-teaching model. A deterrent to implementation is the cost factor of two professionals assigned to a group of students that only one professional has been assigned to in the past (Friend, Reising, & Cook, 1993). Teacher teams will also need to have a common planning time (Friend, Reising, & Cook, 1993; Reynolds & Volkmar, 1984). Decisions involving student numbers and characteristics, as well as classroom management issues must be addressed prior to implementation (Bauwens & Hourcade, 1991; Bauwens, Hourcade, & Friend, 1989; Friend, Reising, & Cook, 1993).

Co-teaching has been reported to benefit students by having someone always available to assist them (Friend, Reising, & Cook, 1993). Co-teachers report a sense of renewal and a development of a dynamic collaborative relationship (Adams & Cessna, 1993). The most significant benefit of co-teaching is the unification of the regular education teacher's expertise in content knowledge with the special educator's expertise of designing instruction for students who learn in atypical ways (Adams & Cessna, 1993). There have also been initial efforts to create a standardized instrument to evaluate co-teaching teams. Utilizing data from the Colorado study, Adams, Cessna, and Friend (1993) developed the Colorado Assessment of Co-Teaching to assist co-teachers in understanding the critical components of co-teaching. The five factors evaluated are: personal prerequisites, the professional relationship, classroom dynamics, contextual factors, and co-teaching foundations.

Co-teaching and Algebra Instruction

The main objective of the secondary mathematics curricula is the development of symbol sense (National Research Council, 1989). Algebra, as the first building block in conceptual mathematics, has been

traditionally taught only to those students who planned to attend postsecondary institutions. Traditional practice placed those students who did not plan to continue their education after high school or had previously performed poorly in earlier mathematics coursework in a general mathematics course. Data from the Fourth National Assessment of Educational Progress (NCTM, 1990) revealed that over one-fourth of the eleventh graders studied had not taken any algebra courses. The comparison of standardized achievement test results of those eleventh graders who had taken algebra at least one year to those eleventh graders who had no algebra instruction indicated an average difference of thirty percentage points (NCTM, 1990). This finding clearly demonstrated that algebra is not intuitive and, therefore, must be studied to be learned.

Algebra instruction involves the introduction of variables. Kuchemann, as part of the 'Concepts in Secondary Mathematics and Science'(CSMS) team (Hart, Brown, Kuchemann, Kerslake, McCartney, Ruddock, 1981), summarized the algebra findings of a five-year study in the United Kingdom. Six interpretations of variables by eleven to sixteen year olds were identified. The

six interpretations were:

1. ...where the letter is assigned a numerical value from the outset.
2. ...ignore the letter, or at best acknowledge its existence but without giving it a meaning.
3. The letter is regarded as a shorthand for an object or as an object in its own right.
4. ...regard a letter as a specific but unknown number, and can operate upon it directly.
5. ...seen as representing, or at least as being able to take, several values rather than just one.
6. ...seen as representing a range of unspecified values, and a systematic relationship is seen to exist between two such sets of values. (Hart et al., 1981, p. 104)

Less than half of the fourteen year olds appeared to have achieved the concept of a variable as a specific unknown (Hart et al., 1981). The algebraic items and the student responses were ranked into four levels of understanding, increasing in complexity and identifying variables as specific unknowns. The four levels of understanding align to Piagetian stages of cognitive

development as listed below:

Level 1 Below late-concrete

Level 2 Late-concrete

Level 3 Early-formal

Level 4 Late-formal (Hart et al.,1981, p. 117)

Kuchemann hypothesized that a sharp improvement in understanding algebraic concepts occurred at age fourteen due to algebra being taught directly. Once the students gained familiarity, "performance was dependent more on cognitive development than on the specific experiences of algebra" (Hart et al., 1981, p. 117).

Sutherland (1991) questioned the idea of cognitive obstacles based on Piagetian theory as described by Herscovics (cited in Sutherland, 1991). Sutherland proposed that "we need to analyze in which ways the practice in the classroom may be contributing to the development of such obstacles" (Sutherland, 1991). Co-teaching provided an opportunity to explore the practices in the classroom from various perspectives.

Computers and calculators also allowed for mathematics education to develop into realistic applications and experiences. Everybody Counts (National Research Council, 1989), a public report introducing the restructuring needs of mathematics

education, stated that "calculators in the classroom can help make higher mathematics more accessible" (p. 62). Calculators and computers provide students the opportunity to explore and question mathematical ideas in a non-threatening environment. "Innovative instruction based on a new symbiosis of machine calculation and human thinking can shift the balance of learning toward understanding, insight, and mathematical intuition" (National Research Council, 1989, p. 63). By developing innovative instructional methods, the NCTM Standards committed to the belief that "all students can benefit from an opportunity to study the core curriculum", which can be "expand[ed] and enrich[ed] to meet the needs of each individual student" (NCTM, 1989, p. 253). The NCTM Standards took a solid stand that mathematics education must shift to instructional methods that include small-group work, individual explorations, and peer instruction (NCTM, 1989). Co-teaching, as documented by the Colorado study (Adams & Cessna, 1993), appears to meet the demands of the NCTM Standards. Co-teaching provided greater opportunity for individualization, instructional variations, and instructional creativity.

Summary

The restructuring of schools and the implementation of the NCTM Standards for School Mathematics creates an environment where regular education teachers are seeking assistance in meeting the diverse needs of their students. The Regular Education Initiative, which encourages the inclusion of all children in the regular classroom with special education support, continues to be debated. Additionally, demands for higher standards and accountability in public education place greater demands on the regular education teacher.

Developing over two decades, co-teaching appears to be a possible solution to relieving some of those demands. Co-teaching has grown from earlier practices in special education services to create a true team approach to educating all students. Current research is just beginning to document how co-teaching has impacted on teacher performance and attitudes, while the impact of co-teaching on student performance is quite limited. This study begins to construct evidence that co-teaching algebra to students with math deficits will improve the students' mathematics achievement and attitudes towards mathematics.

CHAPTER 3

Methodology

Introduction

This chapter outlines the procedures utilized to describe the population, the design and instrumentation of the study. Treatment procedures and statistical analysis for data interpretation are also presented.

Population

The population consisted of high school students in a midwestern school district of approximately 16,600 students enrolled in kindergarten through twelfth grade. There were three public high schools within the district. Each high school had an approximate enrollment of 1600 students, grades nine through twelve. Through random procedures, School A was selected as the pilot site for the study.

Most of the students taking the Basics of Algebra course were ninth graders who had received a C or lower in eighth grade pre-algebra. Students in grades ten through twelve who had been enrolled in General Math were placed in Basics of Algebra, as General Math was no longer being offered. The student population participating in the study included thirty-four females and twenty-five males, with a mean age of sixteen.

Procedures

Class Selection

Students were assigned to one of the ten classes of Basics of Algebra by the district computer. The algebra classes used in the study were selected by the principal of School A, because they were taught the first four periods of the day. This schedule put all of the experimental classes in the morning. Immediately prior to the start of the study, a major re-scheduling of the mathematics students was completed due to the hiring of another part-time teacher. This rescheduling caused some students to change teachers and/or class periods effective the fir t day of the second semester. Class size for the Basics of Algebra classes was reduced from twenty-eight to twenty-two or fewer students per class. The study began on the first day after the re-scheduling had occurred.

Curriculum Description

The Basics of Algebra course utilized the same textbook as the Algebra I course--Merrill Algebra I: Applications and Connections (Foster, Winters, Gell, Rath, & Gordon, 1992). The course, Basics of Algebra, presents the content at a slower rate with greater practice on each concept. Basics of Algebra is, therefore, a two year course. Teachers plan to

cover the first seven chapters of the text the first year. Basics of Algebra and Algebra I are the lowest level of regular education mathematics coursework offered for ninth graders. Prior to the onset of the study, each of the teachers had completed up through the fourth chapter in the textbook. The study began on the first day of instruction for Chapter 5: Inequalities.

Teachers

The study involved two algebra teachers and the special educator/researcher. Algebra teacher-1 had taught mathematics for twenty-four years. Algebra teacher-2 had taught mathematics for thirty-one years. Both teachers had been teaching Basics of Algebra since its conception two years ago. Both teachers taught classes all four periods, and therefore, they did not have opportunity for interactions or comparisons of the day's lesson. The special educator/researcher had thirteen years of secondary special education experience.

Timeline

The study began on the first day of the second semester. It was also the first day of Chapter 5 instruction and of the "new" schedule for students affected by the re-scheduling. The study was conducted

for the three weeks it took for Chapter 5 instruction and assessment.

Instrumentation

For Math Achievement

Gradebooks were used to document achievement. Achievement scores were the percentage of earned points from daily assignments, worksheets, quizzes and the chapter test from the textbook. The teachers maintained their gradebooks throughout the project, without any input from the researcher. The chapter four percentages were used as the pretest covariate for achievement to control for initial differences between the groups in the statistical analysis. The chapter five percentages were considered the post-achievement measure. No reliability or validity data are available for these measures of achievement.

For Math Attitude

The instrument for assessing student attitude towards mathematics was the Test of Mathematical Abilities (TOMA) (Brown & McEntire, 1984). Only the first subtest, Attitude Toward Math, was administered. The subtest consisted of fifteen items which the student marked as agree, don't know, or disagree. The items were written in elementary terms, as this test is normed for ages 8-6 to 18-11. The statements were

worded positively and negatively to encourage accurate answers.

The TOMA was standardized on a sample of 1,560 students in five states representing regions of the United States. The characteristics of the sample reflected the sex, residence, race and region of the United States population as reported in the Statistical Abstract of the United States (1980). Students with special needs were included in the sampling if they were participating in the mainstream setting. Raw scores were converted to scaled scores with a mean of 10 and a standard deviation of 3.

Internal consistency for that subtest was reported by age level as follows:

14-0 to 14-11	.79	15-0 to 15-11	.67
16-0 to 16-11	.74	17-0 to 17-11	.80

Test-Retest data were collected in two settings. The first setting involved eleven year olds with a six-week delay. The Test-Retest correlation was reported as .71. The second setting involved students with learning disabilities with a three-week delay. The Test-Retest correlation was reported as .77.

Validity data were reported for both criterion-related and construct-related validity. The Attitude Towards Math subtest was compared with the Key Math

(.31), the Peabody Individual Achievement Test (.26), and the Wide Range Achievement Test (.31). These coefficients indicated that the attitude subtest did not appear to measure the same domain as the achievement instruments.

Design

The research design for this study involved four groups of students, two algebra teachers and the special educator/researcher. The study was conducted during the first four class periods of the school day for the duration of Chapter 5: Inequalities instruction.

The control group was taught the first period of the day by only Teacher-1. This group continued to receive instruction from only Teacher-1, as they had the first semester. The algebra teacher maintained complete control of this group's instruction and management. The special educator/researcher did not participate in any way with this group, except to administer the pre/post test of the TOMA attitude subtest.

The next two classes were the co-teaching groups. Teacher-2 and the special educator/researcher co-taught algebra in these classes after completing preplanning activities. Teacher-2 and the special

educator/researcher met for two sessions prior to the start of the study. They utilized the implementation model for collaboration by Bauwens and Hourcade (1991) to facilitate their preplanning. Consensus was reached in each of the five components, which are (1) philosophical, (2) theoretical, (3) procedural, (4) instructional, and (5) evaluational considerations. (See Appendix C for Collaboration Model Description.) Teacher-2 and the special educator/researcher mutually planned for instruction during at least one planning session weekly. Together they planned lessons and activities, evaluated progress, taught and managed the classroom. The special educator/researcher was in the room daily, participating actively in the instructional process and classroom management of the group.

Teacher-1 then taught the final group. Students in this group received traditional instruction with in-room assistance from the researcher/special educator. Teacher-1 maintained full control of instruction and classroom management. The special educator was in the classroom daily, assisting individual students who had questions in completing their assignments.

Data Collection

On February 11, 1994, all groups received a brief explanation of the project. Parental permission slips requesting the release of student data for publishing purposes were distributed. All four groups completed the TOMA subtest: Attitudes Toward Math that first day, with the researcher reading the items orally to each group.

Instruction for Chapter 5: Inequalities in the Merrill textbook lasted for the next three complete weeks following the design delineated in this study. The same administration procedures were followed on March 4, 1994, for posttest data on math attitude.

Percentages of total points earned for the chapters (achievement data) were not calculated until the project was completed to insure that the algebra teachers' recordkeeping decisions were not influenced by the researcher of the study. Pre-achievement data consisted of the percentage of total points from the previous chapter, while post-achievement data consisted of the percentage of total points from the treatment chapter. Only data from students who returned signed release forms were utilized in the statistical analysis of data.

Data Analysis

Data collected from the TOMA subtest, Attitudes Toward Math, were converted to scaled scores using the tables provided by the publisher. An analysis of variance (ANOVA) with pretest covariate to allow for initial differences was calculated on the post-treatment attitude data for all four groups.

Teacher gradebooks provided the students' earned points on all assignments and quizzes for Chapter 4 (pre-treatment) and Chapter 5 (treatment). The percentage of earned points was calculated for each student who had returned a signed release form. A one way analysis of variance (ANOVA) with pre-achievement covariate was calculated on the Chapter 5 percentages for all four groups.

After completing an analysis of variance on the groups, additional ANOVAs with covariates were conducted on the subpopulations: females, males, and students receiving special education services. Also, if significant differences were identified, then one way ANOVAs with covariates were conducted comparing data from specific group combinations (i.e., control to coteach1). All data was evaluated to a significance level of .05.

Summary

This chapter provided a description of the population sample and instrumentation components of this study. A detailed review of the treatments and data analysis was also provided to insure the replicability of this study. Chapter 4 contains the results of varying the special educator's role within the adjusted algebra classroom on student math attitude and achievement.

CHAPTER 4

Results

Introduction

With the acceptance of the National Council of Teachers of Mathematics Standards (1989, 1991) and the inclusion of students with math skill deficits in the regular mathematics curriculum, the role of the special educator within the regular classroom needs to be investigated. This study provides empirical support for the effectiveness of including the special educator within an adjusted algebra class by impacting student math attitude and achievement.

This chapter first reviews the population being studied. Next, the statistical methodology is delineated. Finally, the findings are presented first by treatment groups as a whole, then by subpopulations of the groups.

Population Characteristics

The statistics were based on the data collected on fifty-nine students who returned signed release forms. Students placed in adjusted algebra had previously achieved a grade of C or below in eighth grade pre-algebra. Previously, these students would have been placed in a general math or consumer math curriculum.

Of the 18 students assigned to the control group,

eleven students returned release forms, for a return rate of 61%. One of the release forms denied permission, making the number of subjects contributing data ten.

Of the twenty students assigned to traditional instruction with in-room assistance, seventeen students returned consenting release forms. This group's return rate was calculated as 85%.

The two classes of co-teaching had enrollments of eighteen and seventeen respectively. Return rate for each of the co-teaching classes was 94%. Return rate information by group is summarized in Table 1.

Table 1

Summary of Return Rate of Release Forms

Group	Total Enrolled	Consent Given	Consent Denied	Total Returned	Return Rate (%)
Control	18	10	1	11	61%
In-Room	20	17	0	17	85%
CoTeach1	18	16	1	17	94%
CoTeach2	17	16	0	16	94%

Data from this study were analyzed to determine if the independent variables of varying the role of the

special educator in the adjusted algebra classroom affected the dependent variables of student math attitude and achievement. The independent variable varied from traditional instruction to traditional instruction with the special educator providing in-room assistance, and finally to the algebra teacher and special educator equally responsible by co-teaching algebra. Subpopulations within the groups were also identified to determine if varying the role of the special educator affected the attitude or achievement of students who were receiving special education services. Additional subpopulations examined were gender groups.

Table 2

Summary of Student Characteristics

(N=59)

		Sex		Grade Level				
Group	N	Female	Male	9	10	11	12	On IEPS
Control	10	6	4	5	3	1	1	4
In-Room	17	11	6	10	6	1	0	3
CoTeach1	16	8	8	11	4	0	1	4
CoTeach2	16	9	7	14	1	1	0	2

Table 2 summarizes the characteristics of students who returned release forms. The majority of students in all groups were freshmen and sophomores. In the in-room assistance group over half of the students were females. Each group contained a similar number of students receiving special education services.

Findings

Pre-attitude data was collected utilizing the TOMA subtest: Attitude Towards Math. For pre-treatment achievement data, the percentage of total points on the previous chapter in the textbook were utilized. Scores on the TOMA subtest were converted to scaled scores using tables provided in the examiner's manual. Post-treatment data was collected utilizing a retest of the TOMA subtest for attitude and percentage of total points on Chapter 5 in the textbook for achievement.

Group and subpopulation sizes and means for attitude are listed in Table 3. The group and subpopulation sizes and means for achievement are presented in Table 4. These data are the actual pre-treatment and post-treatment means for the treatment groups and subpopulations.

Table 3

Means for Attitude by Group

GROUPS	N	PRE ATTITUDE	POST ATTITUDE
Control	10	5.80	6.80
Females	6	5.50	6.00
Males	4	6.25	8.00
Special Education	4	7.50	8.25
In-Room	17	6.59	6.94
Females	11	7.55	7.09
Males	6	4.83	6.67
Special Education	3	2.67	2.67
CoTeach1	16	7.63	7.31
Females	8	7.38	6.63
Males	8	7.88	8.00
Special Education	4	7.75	6.50
CoTeach2	16	8.00	8.56
Females	9	7.67	8.56
Males	7	8.43	8.57
Special Education	2	7.00	7.00

Table 4

Means for Achievement by Group

GROUPS	N	PRE ACHIEVE	POST ACHIEVE
Control	10	56.00	48.50
Females	6	52.83	31.50
Males	4	60.75	74.00
Special Education	4	59.00	56.75
In-Room	17	47.29	52.94
Females	11	55.64	59.55
Males	6	32.00	40.83
Special Education	3	36.67	42.33
CoTeach1	16	58.00	68.75
Females	8	56.88	63.00
Males	8	59.13	74.50
Special Education	4	57.25	66.75
CoTeach2	16	59.88	65.44
Females	9	68.44	72.56
Males	7	48.88	56.29
Special Education	2	44.50	55.00

The data collected were analyzed to respond to the following research hypotheses regarding attitude:

1. There will be a significant difference in math attitude scores for students receiving traditional algebra instruction compared to co-teaching instruction.
2. There will be a significant difference in math attitude scores for students receiving co-teaching instruction compared to traditional instruction with in-room assistance.
3. There will be a significant difference in math attitude scores for students receiving traditional algebra instruction compared to students receiving tradition instruction with in-room assistance.

No significant differences were identified between treatment group attitudes. Table 5 summarizes the statistical data resulting from the ANOVA with pre-attitude covariate.

Table 5

Analysis of Variance for Attitude

by Group with Pre-Attitude Covariate

(N=59)

Source of Variation	SS	df	MS	F	Signif. of F
Covariate	361.938	1	361.94	93.32	.00
Main Effects Group	9.26	3	3.08	.80	.50
Explained	371.20	4	92.80	23.93	.00
Residual	209.44	54	3.88		
Total	580.64	58	10.01		

A further analysis of attitude toward math by subpopulations was conducted. No significant differences were identified for females between treatment groups, as depicted in Table 6. Table 7 shows there were also no significant differences in male attitude between treatment groups.

Table 6

Analysis of Variance for Attitude

by Females with Pre-Attitude Covariate

(N=34)

Source of Variation	SS	df	MS	F	Signif. of F
Covariate	259.808	1	259.808	143.362	.00
Main Effects Group	14.578	3	4.859	2.681	.065
Explained	274.386	4	68.597	37.852	
Residual	52.555	29	1.812		
Total	326.941	33	9.907		

Table 7

Analysis of Variance for Attitude

by Males with Pre-Attitude Covariate

(N=25)

Source of Variation	SS	df	MS	F	Signif. of F
Covariate	104.613	1	104.613	15.747	.001
Main Effects Group	9.880	3	3.293	.496	.689
Explained	114.493	4	28.623	4.309	.011
Residual	132.867	20	6.643		
Total	247.360	24	10.307		

Students receiving special education services also did not differ significantly in attitude as the special educator's role varied. Table 8 lists the statistical data for this subpopulation.

Table 8

Analysis of Variance for Attitude by Students Receiving Special Education Services with Pre-Attitude Covariate

(N=13)

Source of Variation	SS	df	MS	F	Signif. of F
Covariate	96.92	1	96.92	59.83	.00
Main Effects Group	8.43	3	2.81	1.74	.24
Explained	105.35	4	26.34	16.26	.00
Residual	12.96	8	1.62		
Total	118.31	12	9.86		

Data were also analyzed for the following research hypotheses for achievement:

4. There will be a significant difference in math achievement scores for students receiving traditional algebra instruction compared to students receiving co-teaching instruction.

5. There will be a significant difference in math

achievement scores for students receiving co-teaching instruction compared to students receiving traditional instruction with in-room assistance.

6. There will be a significant difference in math achievement scores for students receiving traditional algebra instruction compared to students receiving tradition instruction with in-room assistance.

A significant difference was identified between treatment groups when achievement data were analyzed as presented in Table 9. To determine between which specific treatment groups the difference occurred, one way ANOVAs with covariates were used. Students scored significantly higher in achievement in the coteach-1 group when compared to the control group. In addition, coteach-1 students also achieved significantly higher than students in the in-room assistance class. Results of the one way analysis are listed in Table 10.

Table 9

Analysis of Variance for Achievement

by Group with Pre-Achievement Covariate

(N=59)

Source of Variation	SS	df	MS	F	Signif. of F
Covariate	12749.25	1	12749.25	56.83	.00
Main Effects Group	2325.59	3	775.20	3.46	.02*
Explained	15074.85	4	3768.71	16.80	.00
Residual	12114.07	54	224.34		
Total	27188.92	58	468.77		

*p<.05

Table 10

One Way Analysis of Variance for Achievement

by Variable Group with Pre-Achievement Covariate

(N=59)

SOURCE	D.F.	SS	MS	F RATIO	F PROB.
Between	3	3866.5366	1288.8455	3.039	.04*
Within	55	23322.3787	424.0432		
Total	58	27188.9153			

*p<.05

Table 11 present the ANOVA with pre-achievement covariate by female subpopulation. It shows a significant difference between treatment groups.

Table 11

Analysis of Variance for Achievement by Females with Pre-Achievement Covariate

(N=34)

Source of Variation	SS	df	MS	F	Signif. of F
Covariate	8476.722	1	8476.722	65.589	.00
Main Effects Group	3875.587	3	1291.862	9.996	.00*
Explained	12352.309	4	3088.077	23.894	.00
Residual	3747.956	29	129.240		
Total	16100.265	33	487.887		

*p<.05

Using a one way analysis of variance with pre-achievement covariate, three significant differences were found between the groups. Females in the in-room assistance group scored significantly higher in achievement when compared to females in the control group. Females in coteach-1 and in coteach-2 also achieved significantly higher than control group females. Table 12 provides the statistical results from the one way ANOVA.

Table 12

One Way Analysis of Variance for Achievement by Variable Group for Females with Pre-Achievement Covariate

(N=34)

SOURCE	D.F.	SS	MS	F RATIO	F PROB.
Between	3	6321.8152	2107.2717	6.4650	.002*
Within	30	9778.4495	325.9483		
Total	33	16100.2647			

*p<.05

No significant differences in achievement were identified for the male students as shown in Table 13.

TABLE 13

Analysis of Variance for Achievement by Males with Pre-Achievement Covariate

(N=27)

Source of Variation	SS	df	MS	F	Signif. of F
Covariate	5370.199	1	5370.199	25.231	.00
Main Effects					
Group	1379.543	3	459.848	2.161	.13
Explained	6749.742	4	1687.436	7.928	.001
Residual	4256.818	20	212.841		
Total	11006.560	24	458.607		

Students receiving special education also did not achieve significantly different between treatment groups. The data are summarized in Table 14.

Table 14

Analysis of Variance for Achievement by Students Receiving Special Education Services with Pretest Covariate

(N=13)

Source of Variation	SS	df	MS	F	Signif. of F
Covariate	1258.75	1	1258.75	4.91	.06
Main Effects Group	398.84	3	132.95	.52	.68
Explained	1657.59	4	414.40	1.61	.26
Residual	2052.72	8	256.59		
Total	3710.31	12	309.19		

Summary

Data were analyzed to evaluate significant differences in student attitude toward math and in math achievement. No significant differences were identified for attitude between groups. Subpopulations of females, males or students receiving special education services also did not score significantly different for attitude.

Achievement data analysis identified significant differences between groups. Students in the coteach-1 group achieved significantly higher than students in the control group as well as higher than students in the in-room assistance group.

Females in the coteach-1 and the coteach-2 scored significantly higher than females in the control group. Females in the in-room assistance group achieved significantly higher than the control group females.

Males and students receiving special education did not achieve significantly different between treatment groups.

CHAPTER 5

Discussion

Introduction

Educators continue to search for effective methods to educate all students within the regular classroom and maintain high standards. Algebra teachers in this study faced this challenge. Students enrolled in the adjusted algebra classes would previously have been placed in a general math curriculum. The placement of students with math skill deficits in algebra is supported by the National Council of Teachers of Mathematics Standards (1991). In addition, the Regular Education Initiative and Public Law 94-142 promote the maintenance of students with disabilities within the regular curriculum with the support of supplementary aids and services provided by special education. Supplementary aids and services could include the placement of a special educator within the regular classroom to provide in-room assistance as requested or to participate actively and equally in the instructional process by co-teaching. Therefore, this study was conducted to identify how the role of the special educator within an adjusted algebra classroom affects the attitude and achievement of students in that setting.

Discussion of Findings

The major findings for the research hypotheses considered in this study are discussed in this section. Research hypotheses were divided by attitude and achievement variables.

Attitude

No significant differences in attitude were identified between groups and subpopulations. One chapter of instruction may not have been long enough to change the impact of the first semester of traditional instruction. The attitudinal findings may be reflective of findings by Lambert, Goodwin, and Wiersma (1965) that the impact of team-teaching may require a longitudinal study.

Achievement

In an adjusted algebra class, students with math skill deficits appeared to achieve significantly better in algebra when a special educator was in the regular classroom setting. Students in the coteach-1 group achieved significantly higher than students in either the control or in-room assistance group. These findings provide support for Klausmeier and Wiersma (1965) study involving low ability students performing significantly better utilizing team-taught instruction. The findings extend Burningham's 1968 (as cited by

Armstrong, 1977) study of fourth grade mathematics students who scored significantly better in team-taught classes.

Females in both co-teaching groups scored significantly higher on the post-treatment measure than the control group females. Females in the in-room assistance also achieved significantly higher than the control group. Consideration must be given to the effect of a female researcher within a male teacher's classroom. Further investigation is needed to determine the role of gender in co-teaching teams.

Co-teaching and in-room assistance models did not impact the achievement of males and students receiving special education services. Students receiving special education services may have needed adaptations throughout their algebra instruction. Without those adaptations, they may not have mastered the earlier concepts necessary to complete higher level algebra tasks. Further investigation is needed to determine why males did not achieve differently in various instructional delivery models.

Recommendations

This study has begun the process of providing empirical support for the inclusion of the special educator within the regular classroom. It appears that

schools should consider the implementation of co-teaching or in-room assistance for classes identified as "adjusted" curricula. Implementation should be well-planned, following the guidelines proposed by Bauwens and Hourcade (1991). Preplanning discussion should include philosophy, theoretical viewpoints, procedures and instructional methods within the classroom, and evaluation practices.

Second, a long-term study regarding the impact of the special educator's role within the regular classroom on student attitude is recommended.

Third, replication of the study into other curricular areas may allow for the generalization of the overall effectiveness of co-teaching and in-room assistance provided by the special educator.

Fourth, further investigation is needed to determine the effect of gender within a co-teaching or in-room assistance team.

Finally, a larger population should be studied to continue to build support for alternative instructional delivery methods.

Summary

Co-teaching appeared to be an effective instructional delivery method for students in an adjusted algebra classroom. Although the results of the study identified no significant differences in attitude between groups, significant differences were identified in achievement. Students in the coteach-1 group achieved significantly higher on post-treatment measures than students in either the control or in-room assistance groups. Females in both co-teaching groups scored higher on achievement measures than females in the control group.

Based on these findings, schools should consider implementing a co-teaching delivery model. As integral parts of their implementation plans, schools will need to provide co-teaching teams with a preplanning conference time, a common planning time for the regular and special educator during the school year, and administrative support. In return, the students in co-teaching classrooms will receive variations in instruction and more individual assistance from a creative and dynamic team of teachers.

BIBLIOGRAPHY

Adams, L., & Cessna, K. (1993). Metaphors of the co-taught classroom. Preventing School Failure, 37(4), 28-31.

Adams, L., Cessna, K., & Friend, M. (1993). Colorado assessment of co-teaching (CO-ACT). Denver: Colorado Department of Education.

Adelman, H. S. (1972). The resource concept--Bigger than a room. The Journal of Special Education, 6, 361-367.

Armstrong, D. G. (Winter, 1977). Team teaching achievement. Review of Educational Research, 65-86.

Baker, J. M., & Zigmond, N. (1990). Are regular education classes equipped to accommodate students with learning disabilities? Exceptional Children, 56, 515-527.

Bauwens, J., & Hourcade, J. J. (1991). Making co-teaching a mainstreaming strategy. Preventing School Failure, 35(4), 19-24.

Bauwens, J., Hourcade, J. J., & Friend, M. (1989). Cooperative teaching: A model for general and special education integration. Remedial and Special Education, 10(2), 17-22.

Brown, V. L., & McEntire, E. (1984). TOMA: Test of Mathematical Abilities. Dallas, TX :Pro-Ed.

Cuban, L. (1986). Persistent instruction: Another look at constancy in the classroom. Phi Delta Kappan, 68(1), 7-11.

deBettencourt, L., Zigmond, N., & Thornton, H. (1989). Follow-up of postsecondary-age rural learning disabled graduates and dropouts. Exceptional Children, 56, 40-49.

Deshler, D. D., Lowrey, N., & Alley, G. R. (1979). Preparing alternatives for LD adolescents: A nationwide survey. Academic Therapy, 14, 389-397.

Edgar, E. (1987). Secondary programs in special education: Are many of them justifiable? Exceptional Children, 53, 555-561.

Ellett, L. (1993). Instructional practices in mainstreamed secondary classrooms. Journal of Learning Disabilities, 26(1), 57-64.

Federal Register. (1992, September 29). 57(189). Washington, DC: U.S. Government Printing Office.

Ford Foundation. (1972). A foundation goes to school: The Ford Foundation comprehensive school improvement program 1960-1970. New York: Ford Foundation.

Foster, A. G., Winters, L. J., Gell, J. M., Rath, J. N., & Gordon, B. W. (1992). Algebra I: Applications and connections. New York: Merrill.

Friend, M. (1988). Putting consultation into context: Historical and contemporary perspectives. Remedial and Special Education, 9(6), 7-13.

Friend, M., Reising, M., & Cook, L. (1993). Co-teaching: An overview of the past, a glimpse at the present, and considerations for the future. Preventing School Failure, 37(4), 6-10.

Haring, K., Lovett, D., & Smith, D. (1990). A follow-up study of recent special education graduates of learning disabilities programs. Journal of Learning Disabilities, 23, 108-113.

Hart, K. M., Brown, M. L., Kuchemann, D. E., Kerslake, M., McCartney, M., & Ruddock, G. (1981). Children's understanding of mathematics: 11-16. London: John Murray.

Hartzell, H., & Compton, C. (1984). Learning disability: 10-year follow-up. Pediatrics, 74, 1058-1064.

Hasazi, S. B., Gordon, L. R., & Roe, C. A. (1985). Factors associated with the employment status of handicapped youth exiting high school from 1979-1983. Exceptional Children, 51, 455-469.

Huefner, D. S. (1988). The consulting teacher model: Risks and opportunities. Exceptional Children, 54, 403-424.

Humes, C., & Brammer, G. (1985). LD career success after high school. Academic Therapy, 21, 171-176.

Idol, L. (1986). Collaborative School Consultation (Report of The National Task Force on School Consultation). Reston, VA: Teacher Education Division, The Council for Exceptional Children.

Idol, L., West, J. F., & Lloyd, S. R. (1988). Organizing and implementing specialized reading programs: A collaborative approach involving classroom, remedial, and special education teachers. Remedial and Special Education, 9(2), 54-61.

Jenkins, J. R., & Heinen, A. (1989). Students' preference for service: Pull-out, in-class, or integrated models. Exceptional Children, 55, 516-623.

Jenkins, J. R., Pious, C. G., & Jewell, M. (1990). Special education and the regular education initiative: Basic assumptions. Exceptional Children, 56, 479-491.

Johnson, D., & Johnson, R. (1986). Mainstreaming and cooperative learning strategies. Exceptional Children, 52, 553-561.

Klausmeier, J. J., & Wiersma, W. (1965). Team teaching and achievement. Education, 86, 238-242.

Lambert, P., Goodwin, W. L., & Wiersma, W. A. (1965). A comparison of pupil achievement in team and self-contained organizations. Journal of Experimental Education, 33, 217-224.

Lewis, A. A. (1974). The resource room program for LD pupils. Academic Therapy, 10, 93-100.

Lilly, M. S. (1977). The merger of categories: Are we finally ready? Journal of Learning Disabilities, 10, 115-121.

Lilly, M. S., & Givens-Ogle, L. B. (1981). Teacher consultation: Present, past, and future. Behavior Disorders, 6, 73-77.

Lipsky, D. K., & Gartner, A. (1987). Capable of achievement and worthy of respect: Education for handicapped students as if they were full-fledged human beings. Exceptional Children, 54, 69-74.

Myles, B. S., & Simpson, R. L. (1989). Regular educators' preferences for mainstreaming mildly handicapped children. The Journal of Special Education, 22, 479-491.

National Longitudinal Transition Study. (1989, March). The transition experiences of youth with disabilities: A report from the NLTS. Paper prepared for presentation to the Division of Research, Council for Exceptional Children, annual meeting, San Francisco.

National Research Council. (1989). Everybody counts: A report to the nation on the future of mathematics education. Washington, DC: National Academy Press.

National Council of Teachers of Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston, VA: Author.

National Council of Teachers of Mathematics. (1990). Results from the fourth mathematics assessment of the national assessment of educational progress. Reston, VA: Author.

National Council of Teachers of Mathematics. (1991). Professional standards for teaching mathematics. Reston, VA: Author.

Price, J. (1991). Effective communication: A key to successful collaboration. Preventing School Failure, 35(4), 25-28.

Pugach, M. C., & Johnson, L. J. (1988). Rethinking the relationship between consultation and collaborative problem-solving. Focus on Exceptional Children, 21(4), 1-8.

Reynolds, C. J., & Volkmar, J. N. (1984). Mainstreaming the special educator. Academic Therapy, 19, 585-591.

Riegel, R. H., & Mathey, J. P. (1980). Mainstreaming at the secondary level: Seven models that work (Bulletin #1427). Wayne County, MI: Intermediate School District.

Sabatino, D. (1972). Resource rooms: The renaissance in special education. The Journal of Special Education, 6, 335-349.

Sansone, J., & Zigmond, N. (1986). Evaluating mainstreaming through an analysis of students' schedules. Exceptional Children, 52, 452-458.

Schalock, R., Wolzen, B., Ross, I., Elliott, B., Werbel, G., & Peterson, K. (1986). Post-secondary community placement of handicapped students: A five-year follow-up. Learning Disability Quarterly, 9, 295-303.

Scuccimarra, D., & Speece, D. (1990). Employment outcomes and social integration of students with mild handicaps: The quality of life two years after high school. Journal of learning Disabilities, 23(4), 213-219.

Simpson, R. L., & Miles, B. S. (1990). The general education collaboration model: A model for successful mainstreaming. Focus on Exceptional Children, 23(4), 1-10.

Stainback, S., Stainback, W., & Forest, M. (1989). Educating all students in the mainstream of regular education. Baltimore, MD: Brookes.

Sutherland, R. (1991). Some unanswered research questions on the teaching and learning of algebra. For the Learning of Mathematics, 11(3), 40-46.

Touzel, S. W. (1978). Secondary LD curricula: A proposed framework. Learning Disability Quarterly, 1(4), 53-61.

United States Department of Education. (1986). To assure the free appropriate education of all handicapped children: Eighth annual report to Congress on the implementation of the Education of the Handicapped Act. Washington, DC: Government Printing Office.

United States Department of Education. (1988). To assure the free appropriate education of all handicapped children: Tenth annual report to Congress on the implementation of the Education of the Handicapped Act. Washington, DC: Government Printing Office.

United States Department of Education. (1990). To assure the free appropriate education of all handicapped children: Twelfth annual report to Congress on the implementation of the Education of the Handicapped Act. Washington, DC: Government Printing Office.

Vatter, T. (1992). Teaching mathematics to the at-risk secondary school student. Mathematics Teacher, 85, 292-294.

West, J. F., & Idol, L. (1990). Collaborative consultation in the education of mildly handicapped and at-risk students. Remedial and Special Education, 11(1), 22-31.

Will, M. (1986). Educating children with learning problems: A shared responsibility. Exceptional Children, 52, 411-415.

Will, M. (1986). Educating students with learning problems--A shared responsibility. Washington, DC: Office of Special Education and Rehabilitative Services, U.S. Department of Education.

Zigmond, N. (1990). Rethinking secondary school programs for students with learning disabilities. Focus on Exceptional Children, 23(1), 1-22.

APPENDICES

APPENDIX A

DISTRICT INFORMED CONSENT FORM

EFFECT OF VARYING THE SPECIAL EDUCATOR'S ROLE WITHIN AN ALGEBRA CLASS ON MATH ATTITUDE AND ACHIEVEMENT

I agree to work with Nancy Rosman on her co-teaching research project. I understand that my participation is strictly voluntary, but I am willing to commit to the time required to complete this project. I understand that Nancy will assume two of the roles as a special educator within the classrooms--assistant and co-teacher. I will be open in my communication with Nancy regarding any concerns or questions I have, as the project progresses.

Upon approval of the University of SD Human Subjects Board, the project will commence. Projected start date is February 1 (or the start of the next chapter). The project duration will be the time it takes to teach 1 (perhaps 2) chapter(s). These decisions will be made prior to the start of the project.

Parental permission forms must be signed for the data on that specific student to be used. I will assist Nancy in obtaining those completed forms. Students will complete a math attitude survey at the beginning and the end of the project. Students' chapter results will be compared to previous results. I agree to give Nancy access to my gradebook for this purpose. ALL INDIVIDUAL STUDENT DATA WILL REMAIN CONFIDENTIAL AND A CODING SYSTEM WILL BE USED TO ELIMINATE INDIVIDUAL RESULT IDENTIFICATION.

Research Objective:

Students with math deficits who are taught algebra using a co-teaching approach will score higher on math attitude and on achievement than students with math deficits receiving in-room assistance from a special educator and traditional instruction.

Basics of Algebra Teacher	Date
Basics of Algebra Teacher	Date

I approve the project described above.

Principal	Date
Superintendent	Date

APPENDIX B

STUDENT DATA RELEASE FORM

EFFECT OF VARYING THE SPECIAL EDUCATOR'S ROLE WITHIN AN ALGEBRA CLASS ON MATH ATTITUDE AND ACHIEVEMENT

You as a member of the Basics of Algebra class at _____ High will be participating in a study comparing various teaching methods. The teaching methods will include traditional, in-room assistance, and co-teaching. I hope to identify which method most improves student achievement as well as student attitude regarding mathematics.

I am an employee of the _____ School District, currently on leave while attending the University of South Dakota. This study has been approved by Principal _____ and Superintendent _____. It has also been reviewed and approved by USD's Human Subjects Committee.

I am requesting your consent to use the results of this comparison for research purposes for my master's thesis and for possible publication in professional journals. No names will be associated with the data. Individual student scores will be coded to insure confidentiality. You consent or non-consent for the release of information will NOT affect your grades in any way.

Thank you for your consideration of this matter. If you have any questions, please feel free to contact me, Nancy Rosman, at _____.

I and my parents/guardians have read and understood the above and agree to the use of my scores for the research purposes given. We understand that if we change our minds about this, we must notify the teacher in writing.

_____ _____

Student Signature Date

_____ _____

Parent/Guardian Signature Date

_____ _____

Researcher Signature Date

APPENDIX C

COLLABORATION MODEL DESCRIPTION

Bauwens and Hourcade (1991) developed a collaboration model to facilitate planning for co-teaching experiences. The five components of consideration are described below. Discussion and consensus should occur before implementing a co-teaching model. Possible discussion issues are provided.

Philosophical--Do both teachers believe that all children can learn the material? On what belief system are each of their teaching philosophies based?

Theoretical--How do the teachers believe children learn best? Are there more than one way to learn?

Procedural--What classroom rules need to be followed? Who corrects tests and assignments? When the teacher makes a mistake, how does s/he wish to be corrected?

Instructional--How will the teaching material be divided? Who will introduce new concepts? What methods and materials will be used?

Evaluational--How will student progress be documented? How will the team be evaluated?

If difficulties arise, the teachers review these components to clarify issues.